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SCIENCE

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CONTENTS

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ADVENTURE, ROMANCE AND SCIENCE[1]

MAN has struggled up a long trail from the past, leaving many competitors extinct along the way, and stands on the high peak of civilization that we enjoy to-day. Even in the old stone age there was plenty of adventure, with perhaps a little romance now and then—yes, and science, too. From the glimpses that ancient documents give into what went on in times long before they were written, and from conditions that obtain among primitive peoples to-day, it seems probable that there have always been scientists among men. These scientists were, and are, peculiar personalities that wanted to know about things. Even to-day they are often looked upon by many of their companions as men of "authority" and at times treated with respect.

In his life cycle every man roughly recapitulates the past, and (alas!) probably the future, history of the human race. This recapitulation is apparent in many ways, but, as civilized man is judged chiefly by his mind, the present discussion will be confined to mental qualities. A child sucks, feels and views his little world with wonder and admiration; thrills with new sensations—gaining in experience day by day. After a time he finds that he knows something, and becomes a delighted critic of his father's table manners and his little sister's English. Approaching maturity, he wants to do something—just what is uncertain—but something must be done. Man has an instinctive urge for a place in the world. Then the golden age comes—the man finds out what the greatest thing in the world is and begins his life work. He trains and works and looks for responsibility and plans, and—if Fortune smiles—may meet with success. After a life spent in labor, the man finds that he is not as important as he thought in the beginning. Then he takes a little time off now and then to enjoy himself, and sometimes develops a certain degree of toleration for others who are trying to live a life. Finally, man spends his old age feeling more or less apologetic for living at all. But hope never seems to die in the human breast and the old man, though left behind by the next generation and in his soul convinced of his perfect uselessness, does not despair. In fact, he gets considerable satisfaction by telling the rising generation about what he claims is a grand life

[1] Presidential address before the Wisconsin Chapter of Sigma Xi, May 2, 1923.

that he has lived, but what is really such a life as he hopes some of his patient advisees will try to live. Thus the cycle goes round.

The army intelligence tests made it apparent to all the world that there are many eccentrics in the cycle of life. Some personalities are arrested in youth. Every one has known persons who went through their lives thrillfully suckling, handling or viewing each experience—and then waiting for something else. These poor souls of course never attain a place in the world. Others miss their place because they do not earn it, but have a pseudo-place given them by Fortune, and they therefore skip from youth to the enjoyment of the pleasures that normally come after the struggles associated with maturity. Some limited personalities are obliged to begin what should be their maturity with the apologies of old age.

It is indeed fitting that after all these ages and chances for failure we should be felicitated on being here to-night—mature, more or less sane personalities; most of us just beginning careers as scientists. We have every reason to feel proud of the human race for its successful domination of the earth and we may rejoice that we of all the people are the personalities endowed with the appropriate qualities to take up work in the greatest field for human endeavor—science.

I might speak to you in an inspiring way concerning our duty to cooperate or discuss the value of science or the grandeur of research. I have talked the matter over with my wife and she assures me that I am enough of a hypocrite to do any of these things well. Better still, and easier, I might by appropriate arguments show what is wrong with science or religion and point out how we might all live better and more scientific lives. However, I am not going to do any of these things, but only make a few more or less irrelevant remarks concerning science and scientists.

President E. A. Birge in a recent address maintained that there are two types of scientists: (1) those who want to know about the world, and (2) those who want to make the world serve them, Darwin and Pasteur being cited as examples of their respective classes. In my opinion there are at least two other classes of persons that call themselves scientists: (3) politicians, and (4) those who are having a good time. All these classes, with the possible exception of the last, furnish their quota of men who are an honor to science. The inquisitive individuals with unquenchable thirsts for knowledge make most of the discoveries; the practical minds make nature an increasingly valuable servant of man; the politicians hold the offices in scientific societies, appoint the fellows and exercise other power-satisfying functions; the joy-riders of science have a good time. My remarks to-night will be primarily to and for the last class. What opportunities does science offer for enjoying life?

In his delightful work on "The Pleasures of Life" Lubbock says,

> "the world would be better and brighter if our teachers would dwell on the Duty of Happiness as well as on the Happiness of Duty; for we ought to be as cheerful as we can, if only because to be happy ourselves, is a most effective contribution to the happiness of others."[1]

The words of such an authority leave no doubt that happiness is both altruistic and scientific. But there are of course various kinds of pleasures, and scientists are undoubtedly worthy of the best. Of all the thrills that man may feel, there are none that have the glamor of adventure and romance.

There are many who feel that Don Quixote, Captain Kidd, Pizarro and other well-known adventurers had all the adventures worth having and that in this modern, do-it-with-electricity and say-it-with-flowers world there are no adventures left that are worth having. There is also a feeling that romance ended with the passing of crusades or that romance is associated with the shinning of fair maids down knotted bed sheets into the arms of poor but worthy lovers, and that Douglas Fairbanks has it syndicated. To convince such doubtful spirits let me quote from the letter that Ross wrote from India after his long struggle to prove that the mosquito transmitted malaria.[2]

> "But now, in order to ensure at least definite negative results, redoubled care was taken; almost every cell was examined, even the integument and the legs were not neglected; the evacuations of the insects found in bottles, and the contents of the intestine were scrupulously searched; at the end of the first examination staining reagents were often run through the preparation and it was searched again with care. The work, which was continued from 8 A. M. to 3 or 4 P. M. with a short interval for breakfast,[3] was most exhausting and so blinding that I could scarcely see afterwards, and the difficulty was increased by the fact that my microscope was almost worn out, the screws being rusted with sweat from my hands and forehead, and my only remaining eyepiece being cracked, while swarms of flies persecuted me at their pleasure as I sat with both hands engaged at the instrument. As the year had been almost rainless (it was the first year of plague and famine) the heat was almost intolerable, and a punkah could not be used for fear of injuring the delicate dissections. Fortunately my invaluable oil-immersion object glass remained good.
>
> "Toward the middle of August I had exhaustively searched numerous grey mosquitos, and a few brindled ones. The results were absolutely negative; the insects

2 Boyce, R. W. 1910. "Mosquito or Man?" London, xvi + 280.

3 In the tropics "coffee" is served in the morning and "breakfast" about noon.

contained nothing whatever. . . . On August 20 I had two remaining insects, both living. Both had been fed on the 16th instant. I had much work to do with other mosquitos, and was not able to attend to these until late in the afternoon, when my sight had become very fatigued. The seventh dappled-winged mosquito was then successfully dissected. Every cell was searched and to my intense disappointment nothing whatever was found, until I came to the insect's stomach. Here, however, just as I was about to abandon the examination, I saw a very delicate circular cell, apparently lying amongst the ordinary cells of the organ, and scarcely distinguishable from them. Almost instinctively I felt that here was something new. On looking further, another and another and another similar object presented itself. I now focused the lens carefully on one of these, and found that it contained a few minute granules of some black substance, exactly like the pigment of the parasite of malaria. I counted altogether twelve of these cells in the insect, but was so tired with work, and had been so often disappointed before, that I did not at the moment recognize the value of the observation. After mounting the specimen I went home and slept for nearly an hour. On waking, my first thought was that the problem was solved, and so it was.

"The mind long engaged with a single problem often acquires a kind of prophetic insight, apparently stronger than reason, which tells the truth, though the actual arguments may look feeble enough when put upon paper. Such an insight is mainly based, I suppose, on a concentration of small probabilities, each of which may have little weight in itself; but in this case, at all events, the insight was there, and spoke the truth."

Oh, boy! Is this adventure? Is this romance?

My friend, Professor H. C. Cowles, recently had an enjoyable experience. Years ago, Cowles had a lot of fun determining what relation the growth rings in tree trunks and the general shape of trees had to wet and dry ground and to rain and drought. Recently the United States sued some lumbermen in Arkansas for cutting timber that did not belong to them. In court the culprits claimed that they had acquired rights by the purchase of claims from early settlers, who had lived on the shore of a lake that dried up about 1840. The whole case hinged on whether there had been a lake or not. Well, Cowles went down there and proved scientifically and conclusively, using cypress trees and stumps as evidence, that there had not been any lake present for at least 150 years. The government got its money all right and incidentally (just to make the joke complete) Cowles got his. If there is any man on earth who has a good time, it is Cowles.

The young man in science says: What are my opportunities? What can science do for me? It is my privilege to point out to him that scientists are a picked, unusual, privileged lot of people, who are much superior and enjoy superior opportunities to those in any other walk in life.

For example, the broker comes home at night and says:

"Friend wife, the lambs have been swarming this week and I brought home a couple of pearl necklaces. If you do not want them just take them back to Spiffany's and exchange them for something else."

"Thank you so much," says the wife.

The scientist returns to his joyful home and says: "My dear, I have received notice that the Finnish Society for the Discovery of Paleolithic Artefacts has elected me to honorary membership."

"Is that not fine? I am so proud!" says the wife. "I have had a pleasant day, too. I am making over my wedding gown and it is going to look real nice. By the way, John's shoes are all worn out."[4]

A prominent scientist has recently published a spirited resentment and disgustatory against American men of science.[5] This man can not sleep because scientists do not demand and get the money that they really earn. He claims that scientists really contribute all the big ideas to commerce and get little or nothing in return. In fact scientists are often actually obliged to beg for a little money in order to enjoy themselves doing research. This writer has, I feel, missed the point of science. The basis for all *social* procedure is *custom,* and while a man goes into science to make discoveries, help his fellows, manage other scientists or even to have a good time, he *never* goes into science to make money. It is not done; that's all. If a scientist tried to do such a thing, he would of course be "impure." To be sure, a scientist can not be blamed if he incidentally does earn a little money through no fault of his own, but to start out maliciously to do it is scandalous. As a reward for going without money, scientists enjoy peculiar social privileges that are more or less associated with the fact that they are not concerned primarily with making a modest or a magnificent living, but with the increase of knowledge. The opportunity to think free thoughts, to know and discover are worth more than money to a scientist.

Now, I feel that I ought to admonish the young scientists that they, being of the elect of the earth, should be dignified and moderate in all things. They should in any and all joyful pursuits of course have a good time, but also remember that there are persons in the world who wish to be treated with respect and many who wish to sleep. A young Californian hurt the feelings of a lot of thoroughly scientific geneticists by crassly improving a considerable number of plants in order to help out some common horticultural

4 There is more of this dialogue, but, as much of it has no direct bearing on science, I do not quote in full, feeling that enough has been rendered to give the "atmosphere" which is more or less familiar to scientists.

5 *Sci. Mo.,* 14: 567–577.

friends of his. A scientist in New York has not only grossly offended a number of his colleagues by refusing to accept certain good old traditions, but during one of his joyrides actually threw mud at the image of God. Such unnecessary occurrences are of course regretted by all, and should be avoided because they are likely to give science a bad name.

Witmer[6] says: "Intelligence is the ability to solve new problems . . . Education is the device of civilization to keep from encountering new problems." A scientist lives largely on ideas. The late John O. Reed once said of one of his colleagues: "I do not particularly mind him, because I know that he really does not think. He only thinks that he thinks." Any one who reads scientific journals soon learns that a certain proportion of the scientific world belongs in the same class with Dean Reed's friend. But, after all, one of the fine things about the scientific attitude of mind is that those who have it think what they please, without fear or prejudice or self-interest. Facts are facts. They require no apologies. Scientific spirit is bound at times to lead those who possess it into conflict with authority and established institutions. But it can not be suppressed. Science is always right because it seeks only for truth, and truth hurts no one. Unfortunately, scientists are not always right.

A scientist has his circulating medium in problems. He deals in and develops problems as a broker deals in stocks and bonds. When his problems are completed he "sells" them to the scientific world by publication, usually at his own expense. For a scientist there is no joy like that of working in his chosen field. Holmes said: "What have we to do with time but fill it up with labor?" To work, to know, to discover and create—for a scientist there is nothing beyond this!

A "real" or "pure" scientist can have little pleasure from life if he begins his career by craftily seeking out the best "field" or "opportunity." Modern genetics tells us that we are preordained to be osteocephs or geniuses. If one works and worries day and night for forty years on what he loves most, he may amount to something, and he may not. Genetics alone knows and it won't tell. At least we can enjoy ourselves. The greatest thing any man can do for science is to respect himself, love his work—and keep working. I wish you scientists a long and happy life—adventurous and romantic.

A. S. Pearse

University of Wisconsin

[6] *Sci. Mo.*, 15: 57.

THE MAINTENANCE OF ORGANIC MATTER IN SOILS

None of the hypotheses for the origin of the earth make any provision for the presence of combined nitrogen in the lithosphere. All productive soils, however, contain this element in some form generally closely related to the organic matter present, and nitrogen is one of the plant food elements essential to the development of all higher forms of plant life. The atmosphere must, therefore, be the primary source of all soil nitrogen, and its incorporation in the soil is dependent upon precipitation, free fixation and the fixation power of legumes. Such incorporation has had an opportunity to continue for long geological periods with the result that there has been a gradual accumulation. Under conditions where there have been no losses through leaching, this accumulation is not only directly proportional to the precipitation received, but naturally also to the amount of vegetative growth produced on the soil. The tendency has been in nature to convert this nitrogen into an organic form and it is in this form that practically all of the soil nitrogen exists. Results from various soil investigators working in widely different climatic sections have shown that the ratio between the nitrogen and the organic matter and also between the carbon and the organic matter is practically a constant. This constancy is so well established by experimental data that the approved methods for determining soil organic matter are based on the carbon and nitrogen content of the soil.

$$\text{Organic matter} = \text{Carbon} \times 1.724$$
$$\text{or Organic matter} = \text{Carbon dioxide} \times .471$$
$$\text{or Organic matter} = \text{Nitrogen} \times 20$$
$$\text{then } \frac{\text{carbon}}{\text{nitrogen}} = \frac{20}{1.724}$$
$$\text{or Nitrogen : Carbon} :: 1 : 11.6$$

This ratio of practically 1:12 is established by nature at a point where it has a very pronounced relationship to productivity. It is found that where organic matter composed largely of low nitrogen-carrying material is applied to a soil, nitrate accumulation is inhibited to the extent that crop development is retarded. This effect on nitrate accumulation is felt until sufficient carbon has been eliminated as carbon dioxide in the process of decomposition to establish a nitrogen-carbon ratio of about 1:12 in the remaining material.

Under natural conditions where no special effort is made to encourage nitrification and where all vegetative growth reverts to the soil, plant development

will take place about as rapidly as nitrogen becomes available, so that all possibilities of nitrogen losses through leaching are largely eliminated and a gradual increase in the organic matter proportional to the increase in nitrogen must and does follow and the 1:12 nitrogen-carbon ratio is maintained. It is only under conditions of intensive tillage where excessive amounts of nitrogen are removed regularly by cropping or leaching that there can be any very pronounced loss of organic matter. In this process of organic decomposition the carbon is lost more rapidly than nitrogen with the result that the nitrogen-carbon ratio is always slightly narrower in cropped than in virgin soil. The close relationship between nitrogen and carbon makes it impossible to increase or maintain organic matter in the soil unless nitrogen is increased or maintained in like proportion, and, conversely, it is impossible to increase the organic nitrogen without a proportional increase in the total organic matter.

Because of the fact that the benefits of soil organic matter in its relation to available plant food and to physical condition are thoroughly appreciated, attempts have been made to increase this material in the soil, but nearly always with disappointing results. To effect such increase in a measurable degree during the short periods over which records have been kept would require what in reality amounts to a change in climatic conditions. Under irrigated conditions, where the introduction of water on a soil well adapted to legume culture and decidedly deficient in nitrogen meant a heavy production of vegetation and a rapid fixation of nitrogen, it has been possible to increase the organic matter in the soil over and above that in the virgin state. This is practically the only condition under which increases are possible. Under other climatic conditions all attempts at even maintenance have been confronted with many difficulties and disappointments.

In the humid sections liberal annual applications of manure for long periods have had little or no permanent effect, while in the arid regions the return of straw to the soil can not be justified on the basis of improved physical condition of the soil resulting from an increase of soil organic matter. These results are readily explainable when it is realized that manure contains only about ten pounds of nitrogen per ton, and when applied at the rate of ten tons per acre will not more than supply the nitrogen removed by leaching and cropping. In the case of straw, which also contains about ten pounds of nitrogen per ton, and which is recommended for application at the rate of about one ton per acre, practically no influence is felt and little should be expected, because, true to the constant nitrogen-carbon ratio, these ten pounds of nitrogen can fix only about 120 pounds of carbon or a total of about 200 pounds of organic matter, a smaller amount than needs to be decomposed to supply the nitrogen required for one crop.

To maintain soil organic matter, emphasis should be placed on the nitrogen, and if this element is maintained sufficient carbon will be fixed. Nitrogen can be maintained, in part at least, through the use of fertilizers and the growth of legume crops. Even where inorganic fertilizers like sodium nitrate or ammonium sulphate are applied in connection with straw or other low nitrogen-carrying residues much of the nitrogen will be fixed with the carbon in an organic form in the process of decomposition. In the case of maintenance with legumes, worn-out soils can be decidedly influenced, as is evidenced by the pronounced improvement in the physical condition following immediately after the legume sod is broken up. When manure or strawy crop residues are applied this effect is not nearly as pronounced. In one case there is not sufficient carbon to fix all the nitrogen and large amounts are made available either to be lost by leaching or to cause a lodging or burning effect on the succeeding crop, while in the other case there is too much carbon for the nitrogen and in the process of decomposition much carbon is lost and little nitrogen is made available. This also results in decreased yields.

In sections where climatic conditions make it necessary to follow a legume sod with small grain, a crop that does not require excessive amounts of nitrogen, but nevertheless is decidedly dependent on small amounts of available nitrogen early in the season, difficulty is experienced in maintaining the organic matter supply.

The ill effects of legumes or straw used singly can be overcome by introducing the straw as a surface dressing on the legume sod before it is broken up. Besides this, it is reasonable to assume, consistent with the constancy of the nitrogen-carbon ratio, that much of the nitrogen and carbon that would be lost in the process of decomposition where the materials are used singly is now fixed, thus resulting in the more rapid accumulation of desirable soil organic matter.

F. J. SIEVERS
WASHINGTON AGRICULTURAL EXPERIMENT STATION

MEDICAL LICENSURE OF NON-MEDICAL DOCTORS

WHAT would result if most of our scientific laboratories were placed in charge of physicians? This question may be countered by saying that no one ever entertained such a thought; why raise needlessly a troublesome question? But House Bill No. 348 in the Pennsylvania legislature now in session provided

That no laboratory procedure for the diagnosis or treatment of human disease shall be performed or reported by persons who have not a license to practice Medicine and Surgery . . . , except under the direct supervision and upon the personal responsibility of a physician. . . .

The duty of the State was mapped out before the Section on Pathology and Physiology of the American Medical Association at St. Louis, May, 1922, and House Bill No. 348 was in accord with the view there expressed:

As long as non-medical laboratorians . . . submit reports to physicians only, it may be granted that it makes little difference to the State whom the physician calls on for these examinations or for even the interpretations of the results. . . . But provision should be made for the examination and licensure of the doctors of philosophy and hygiene and other technicians who are not doctors of medicine. . . .

Whatever appeal this naïve statement makes is changed when one reads further from the same hand:

Many physicians—probably the majority—give little or no attention to the qualifications of those to whom their laboratory work is entrusted. . . . As a general rule, practicing physicians do not realize the many chances for error in laboratory work; "to them a test is a test regardless of by whom or how it is made."

The reader will find it an interesting excursion through the two papers presented and the discussion thereby evoked, in the meeting at St. Louis.[1] Doctors of philosophy and hygiene will find, supplied by doctors of medicine, details lacking in the definition of the word *technician*: ". . . a technician (perhaps some girl who has had a year or so training);" "usually some girl who is looking for a job or a relative of the doctors;" ". . . a girl, with or without a high school education."

In Pennsylvania we had to meet a situation. House Bill No. 348 had passed first reading before the chemists learned of its existence. Its wording was found to include every laboratory procedure related in any way to human disease. It provided for the summary closing of a laboratory without hearing or appeal. It created a laboratory monopoly for physicians. By it doctors of philosophy were disqualified from practicing the laboratory procedures they are paid by physicians to teach young physicians how to do. Druggists and owners of pharmaceutical laboratories were compelled, on pain of closure, to take on physicians as partners. The genius of the evils this bill was said to remedy appeared to be *Frankenstein*, with the given name "Technician," who is inflicting retribution upon his creators. All of the evils complained of were already capable of correction by proper enforcement of the Medical Practice Act of the Commonwealth.

If my reader is himself a physician he may better picture the potentialities in such a bill by using an analogy. Let him suppose the State Bar Association has a law passed putting all laboratory procedures relating (ever so remotely, perhaps) to crime under the direct supervision of a lawyer. Let him follow out the analogy and try to select in his own community the lawyer honestly capable of such supervision over a biologist or chemist or physician. Let him see the lawyer-partner in every doctor's office, in every drug store and food factory and every other business or profession in which the crime of adulteration or any other malpractice may enter. The possibilities of this analogy are great, and its pursuit illuminating.

The many factors in law and medicine and religion that rest upon tradition or prejudice are, in time, doomed. The development of the essentials to civilization can not but be attended with great travail. But the methods of the middle ages are behind the times; and abuse of power (even with good intentions) is insufficient to solve difficulties incident to intellectual evolution.

The spectacle of House Bill No. 348 makes it wise for doctors of philosophy and hygiene and many others to watch their legislatures. Something may happen in any of the states any time. It would be inexplicable if a considerable number of physicians should support House Bill No. 348 or other bill equivalent to it. To do so would be to invite a fight that can end in but one way. A contest with highly trained men whose lives are spent in exact experiment and careful reasoning is not to be undertaken lightly. Considerations of policy, alone, would suggest caution. When enough has been done to lead doctors of philosophy and hygiene in this country to tell laymen convincingly the indisputable truth about the doubts and shortcomings and failures of medicine, to lead druggists to add to this what they know by experience of the physician in the prescribing and compounding and dispensing of medicines, to lead pharmaceutical manufacturers to add to this the facts of experience gained in making their advertising and sales campaigns among physicians successful—what will be the outcome financially for the average practicing physician?

House Bill No. 348 was *killed in committee* and escaped the publicity due it had it come before the House and Senate for discussion. But parties at interest over the whole country should know about it. "Forewarned is forearmed."

DAVID WILBUR HORN, PH.D.,
Chairman, Committee on Legislation,
Phila. Section, American Chemical Society

[1] *Journ. Amer. Med. Assoc.*, 1922, p. 861 ff.

SCIENTIFIC EVENTS

THE ANNUAL REPORT OF THE BRITISH MUSEUM

THE annual report of the British Museum for 1922 records that the number of visitors to the museum continues to rise. The total for 1922 was 979,297, an increase of 78,000 over the preceding year, and the highest figure recorded in this century. Of these visitors, 918,354 came on week-days and 60,943 on Sundays. The visits of students to particular departments also increased, though in a smaller proportion. The visits to the reading room were 164,775, as against 159,177; those to the newspaper room 10,941, as against 10,034; and those to other departments 31,291, as against 27,391.

The number of separate objects incorporated in the collections in 1922 was 388,566, as compared with 369,335 in 1921, the most striking increase being in the Department of Coins and Medals.

The total number of visitors to the Natural History Museum during 1922 was 498,841, as compared with 479,476 in 1921. The attendance on Sunday afternoons was 74,197, as against 61,511 in the previous year, and the number of persons present at the demonstrations of the official guide during the year was 14,515, an increase of 1,040 on the number—13,475—for 1921. The average daily attendance for all open days was 1,374; for week-days, 1,370; and for Sunday afternoons, 1,400.

At the beginning of November the Northern Geological Galleries were added to those open to the public on Sunday afternoons, thus removing the last remaining difference between Sundays and week-days with regard to the exhibition galleries open to visitors.

THE BUREAU OF PHYSICO-CHEMICAL STANDARDS AT BRUSSELS

THE function of the Bureau of Physico-Chemical Standards, established by the International Union of Pure and Applied Chemistry, is the study of the preparation of standard substances to be used as reference substances for physico-chemical measurements carried out in the various laboratories of the world. Samples of the following standard substances are now available for distribution to the chemists of those countries belonging to the union.

A. Standard substances prepared at Brussels and intended primarily for the calibration of low temperature thermometers. The freezing points of the following substances reproduce to $\pm 0.1°$, the scale of the helium thermometer of the Cryogenic Laboratory of the University of Leyden (Compt. rend., Vol. 174, p. 365, 1922).

Carbon tetrachloride	— 22°, 9
Chlorbenzene	— 45°, 2
Chloroform	— 63°, 5
Ethyl acetate	— 83°, 6
Carbon disulphide	— 111°, 6
Ether (stable form)	— 116°, 3
Ether (metastable form)	— 123°, 3
Methylcyclohexane	— 126°, 3

Fifty cc. samples of each of these substances are available in ampoule at 25 Belgian francs per sample. All orders should be addressed directly to the bureau. Other materials are in course of preparation.

B. Supplementing the preparations of the bureau are the following standard materials prepared by the U. S. Bureau of Standards at Washington and obtainable directly from that Bureau (Bureau of Standards Circular No. 25): Cane-sugar, for calorimetry and saccharimetry; naphthalene, for calorimetry; benzoic acid, for calorimetry; sodium oxalate, for oxidimetry; dextrose, for use as a reducing agent; benzoic acid, for acidimetry; tin, zinc, aluminum, copper and lead, with stated melting point, for use in thermocouple calibration.

All the above standard samples are accompanied by instructions for use.

The Bureau of Physico-Chemical Standards plans to act as a center for the study of pure materials, and it requests that authors of papers in this field send reprints of their papers to the bureau. It also hopes that industrial organizations may be willing to contribute to the bureau materials which may be used as the starting point for the preparation of highly purified substances.

THE MOORE SCHOOL OF ELECTRICAL ENGINEERING AT THE UNIVERSITY OF PENNSYLVANIA

THROUGH a merger with the Moore School of Electrical Engineering, provided for in the will of the late Alfred Fitler Moore, as a memorial to his parents, the University of Pennsylvania is to become the seat of one of the best-equipped and endowed schools of electrical engineering in America. This became known through an announcement by Provost Josiah H. Penniman of an agreement between the Moore trustees and the trustees of the university by which the two are to be merged under the name of the Moore School of Electrical Engineering. The new school is to have the income from a fund of $1,500,000 left by Mr. Moore, as well as the funds hitherto at the disposal of the university's electrical engineering department.

In announcing the establishment of the new school, Provost Penniman said:

The university has already available in its present engineering building sufficient space for this new school, at least for the present, and also ample modern equipment to take care of the present needs of this school; for the entire equipment of the electrical engineering

department of the university will become the equipment of the Moore School of Electrical Engineering.

The income from the Moore fund will be available to meet the yearly expenditures necessary to provide instruction of the highest grade in electrical engineering. The increased income thus rendered available for training students of electrical engineering will be used not only to improve what we have already found to be good, but also to develop the subjects through original investigation carried on by faculty and students, so that the school will almost at once take a foremost position among schools of electrical engineering.

There will be additions made to the teaching staff to make it possible to give to each student individual and intimate and personal attention, and these additions will be men of ability as inspiring teachers and also investigators of recognized standing.

The new school, which will probably be ready for operation in the fall, will bear somewhat the same relationship to the university as does the Thomas W. Evans Institute, which is the School of Dentistry of the university. Mr. Moore, who was a manufacturer of insulated wire, died on September 18, 1912. Under the terms of his will, his estate was retained in trust during the lifetime of his wife, Emily Louisa Moore, who died this year.

DARWINISM AND MR. BRYAN

A press dispatch to the daily press from Atlanta under the date of July 24 reads:

Organization of Southern Legislatures against the menace, as he sees it, of the teachings of Darwinism or agnosticism in public schools, is apparently the present undertaking of William Jennings Bryan. In the past several months Mr. Bryan has visited virtually every general assembly in the south, and asked the legislators to go on record as opposed to the teaching of such doctrines. So far as known he has met with more than fair success.

A measure cropped up in the Georgia Assembly yesterday which if adopted would give it as the "sense" of that body against the teaching at all of atheism or agnosticism and of Darwinism as truth in any of the State's public institutions. Mr. Bryan spoke in behalf of such measures several days ago.

When the Florida Legislature was in session in April and May, Mr. Bryan appeared with a prepared speech against those who believe they descended from monkeys, the disbelievers and those who profess ignorance. A resolution placing that assembly on record as opposed to anti-religious teachings in the public schools of that state was passed. He also went before the Arkansas Legislature and others.

The stereotyped resolution as written by Mr. Bryan for presentation in the various state assemblies has been modified and seldom encounters any opposition now. The insertion of the words "as truth" in the reference to the teachings of Darwinism has served to embarrass opposition.

AWARD OF THE DANIEL GIRAUD ELLIOT MEDAL

The committee of the Daniel Giraud Elliot Medal desires to receive nominations for the awards of the years 1921 and 1922, which are still open, because the committee has not been able to reach unanimous conclusion on any work thus far brought to its attention. The Elliot Medal is awarded for some especially great contribution, not for general accomplishment, in the field of either zoology or paleontology. It is not restricted in either branch to the vertebrates, but may be made in either the vertebrate or invertebrate field and is open to scientists of the world. Some idea of the character of the award may be gained from a review of the previous awards, which were made in 1917 to Frank M. Chapman for his "Distribution of Bird Life in Colombia," in 1918 to William Beebe for his "Monograph of the Pheasants," in 1919 to Robert Ridgway for his "Birds of North and Middle America" (Part VIII), and in 1920 to Othenio Abel for his "Methoden der Palaobiologischen Forschung." The award of the beautiful gold medal is accompanied by a generous honorarium. The committee desires to receive further nominations for the two years mentioned, namely, 1921 and 1922, and also for 1923. Communications should be addressed to the Secretary of the National Academy of Sciences, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

At the last meeting of the Botanical Society of America, provisions were put into effect for the election of corresponding members from among distinguished contributors to the science of botany. The first members elected were Professor Hugo de Vries, of Holland, and Professor F. O. Bower, of Glasgow.

Dr. D. T. MacDougal, of the Carnegie Institution of Washington, has been elected an honorary fellow of the Botanical Society of Edinburgh.

Dr. Ralph L. Thompson, St. Louis, has resigned as professor of pathology at St. Louis University School of Medicine, following twenty years of service. The university has decided to name the museum the Ralph L. Thompson Collection of Pathological Specimens.

Eugene H. Pool, M.D., of New York, has been awarded a distinguished service medal with the following citation: "As surgical consultant with the 4th Corps, 5th Corps, and then the 1st Army, he displayed unusual organizing ability, excellent judgment, and professional attainments of the highest order in directing the work of surgical teams in the care of large numbers of wounded in various hos-

pitals at the front during the St. Mihiel and Meuse-Argonne offensives, thereby rendering services of great value to the American Expeditionary Forces."

THE University of Maryland has conferred the degree of doctor of science upon Lore A. Rogers, bacteriologist in charge of the Dairy Research Laboratories of the U. S. Department of Agriculture, in recognition of his researches in bacteriology and dairy technology.

THE honorary degree of doctor of science was conferred at commencement by Smith College on Dr. Florence Gilman, chairman of the department of hygiene and physical education at the college.

THE degree of doctor of laws has been conferred by the University of Birmingham on Dr. F. W. Aston, of the University of Cambridge, in recognition of his distinguished contributions to chemistry.

AT the Cambridge meeting of the Society of Chemical Industry, Dr. E. F. Armstrong was elected president. The vice-presidents are Dr. T. H. Butler, Mr. F. H. Carr, Professor G. G. Henderson and Mr. E. Mond.

THE last list of British honors contains the names of the following men known for their scientific work: *Baronet:* Sir Anthony A. Bowlby, president of the Royal College of Surgeons. *Knights:* Dr. G. F. Blacker, dean of University College Hospital Medical school, and Professor W. M. Flinders Petrie, Edwards professor of Egyptology, University College, London.

THE prize founded by the king of Italy at the Accademia dei Lincei, Rome, was divided this year between Professors G. Levi and U. Pierantoni, of the University of Turin, for work on "Normal and pathologic morphology."

THE National Alliance for the Increase of the French Population has awarded the first prize of 50,000 francs to M. Paul Haury for the best popularly written pamphlet on the decreasing birth rate and the tragic consequences to the nation. Forty-four other prizes for essays on depopulation, ranging from 1,000 to 8,000 francs, were distributed. Half a million copies of Haury's booklet are to be printed at once.

DR. T. ROYDS has been appointed director of the Kodaikanal and Madras Observatories in succession to Mr. J. Evershed, who retired on February 25.

DR. B. COLEMAN RENICK, graduate of Chicago University and recently on the teaching staff of the University of Iowa, has been appointed assistant geologist in the ground water division of the U. S. Geological Survey and began work in Montana on July 1.

DR. ROSCOE W. THATCHER has been appointed director of the Experiment Station at Cornell University. Under this appointment, Dr. Thatcher will direct the agricultural research at the state station at Geneva, as formerly, and also at the Cornell University station at Ithaca.

DR. E. S. LARSEN, JR., who, as was recently announced, has been appointed professor of petrography at Harvard University, will relinquish his work as chief of the section of petrography of the U. S. Geological Survey on September 1.

JOHN C. BRIER has resigned as professor of chemical engineering at the University of Michigan to engage in the development of technical service for the Glidden Company.

F. W. SULLIVAN, JR., has resigned from the teaching staff of the department of chemistry at the University of Michigan to go into research work with the Standard Oil Company (Indiana) at Caspar, Wyo.

PAUL M. GIESY has been made director of the Brooklyn Research Laboratories of E. R. Squibb & Sons.

C. C. CONCANNON, for the past eight months acting chief of the division of chemistry of the Bureau of Foreign and Domestic Commerce, has been appointed chief of the division.

DR. LOUISE STANLEY, a native of Nashville, Tenn., and now dean of home economics at the University of Missouri, Columbia, Mo., has been selected by Secretary Wallace to head the newly established bureau of home economics of the Department of Agriculture. She will begin her work on September 1.

DR. N. L. BOWEN, petrologist, of the Geophysical Laboratory, Carnegie Institution of Washington, is spending the summer studying the igneous rocks of England, Scotland, Norway and Sweden.

MR. W. A. F. BALFOUR BROWNE, of Caius College, Cambridge, sailed on June 14 for Rio de Janeiro with a small expedition, returning in September or October. The object is to observe the land fauna of the tropics under natural conditions, *i.e.*, the structure of the animals and particularly insects, in relation to the functions they perform. The members of the expedition are Mr. L. H. Matthews, of King's (Mammals), Mr. W. S. Bristowe, of Caius (Spiders), Mr. G. L. R. Hancock, of Trinity (Ichneumons), Mr. Cott (Hymenoptera), and Mr. Sanders, a research student in the Molteno Institute (Parasitic Insects).

MR. J. M. WORDIE, geologist of the Shackleton Expedition of 1914, has left Bergen with a party from Cambridge University for East Greenland, where

three months will be spent in scientific investigations. An expedition under Mr. Chaworth Musters, who accompanied Mr. Wordie to Jan Mayen Island in 1921, has left for Franz Joseph's Land.

Sir Thomas Oliver, the distinguished British authority on occupational diseases and member of the anthrax committee of the League of Nations, expects to visit this country during September and early October. Sir Thomas intends to make industrial plant inspections of oil refineries, by-products, coke ovens, steel works, asbestos mills, potteries, of which Sir Thomas has made a special study, white lead works, sugar refineries, limestone mills, packing houses, woolen and cotton mills, rubber factories, paper mills, etc. He is expected to reach Boston by October 6 in time to address the American Public Health Association. His visits will include Harvard, Yale, Johns Hopkins and Tulane Universities. His itinerary is in charge of Dr. Frederick L. Hoffman, consulting statistician of the Prudential Insurance Company.

Dr. S. F. Acree has been in Washington conferring with government chemists working on colloids. Professor Acree states that he now is able to take microphotographs of 3,000 diameters in the fiftieth of a second, which makes possible the securing of motion pictures showing the progress of microscopic reactions.

Professor J. W. McBain, of the University of Bristol, is to give a dedication address in connection with the opening of the Chemical Laboratory at Brown University.

The nineteenth Dutch Congress of Medical and Natural Sciences was held recently at Maestricht under the chairmanship of Professor Spronck, who gave the opening address.

Dr. Edgar F. Smith recently returned from a trip to Louisiana, Texas and Arkansas, where he addressed sections of the American Chemical Society and delivered commencement addresses at Rice Institute, Texas, and at the University of Arkansas. He spoke at Tulane University, and at Rice Institute officiated in the ceremony of breaking ground for a new chemical laboratory, presenting the authorities with an autograph letter of Joseph Priestley, the discoverer of oxygen.

On June 22 there was installed on the campus of the University of Oregon the Oregon Chapter of the Society of the Sigma Xi, with a charter membership of twenty-seven. Professor Henry B. Ward, national president of the society, and Professor Edward Ellery, national secretary, were the installing officers. A noticeable feature of the meeting was the large attendance of visitors from neighboring institutions, Oregon Agricultural College, Reed College, University of California, and University of Washington being represented. The following officers were elected: *President,* Dr. A. E. Caswell; *vice-president,* Dr. G. E. Burget; *secretary,* Dr. H. B. Yocom; *treasurer,* Dr. H. R. Crosland.

On July 11, Professor Edward Kasner, of Columbia University, spoke on "La courbure de Ricci et sa généralization" at the meeting of the Société Mathématique de France in the Sorbonne; and Professor J. F. Ritt spoke on "Les fonctions algébriques qui s'expriment par des radicaux."

It is stated in *Nature* that the centenary of the death of the horologist, Abraham Louis Bréguet, will be celebrated in Paris, October 22–27, by an exhibition of his works at a special meeting at the Sorbonne, and a reception at the Hôtel de Ville. The Congrès National de Chronométrie will also meet in Paris in October, under the honorary presidency of M. Bailland, director of the Paris Observatory, and of General Sebert. Besides discussing general questions relating to chronometry, the congress will aim at the formation of a Chronometric Union under the direction of the International Research Council.

A circular tablet of blue glazed ware bearing the inscription "James Clerk Maxwell (1831–1879), Physicist, lived here," has been affixed to 16 Palace Gardens Terrace, Kensington, where Clerk Maxwell resided for a time, by the London County Council. Maxwell's occupation of the house probably dated from the latter part of 1860, immediately after his appointment to King's College, or the early part of 1861.

Dr. F. C. Cook, for twenty years physiological chemist of the Bureau of Chemistry, U. S. Department of Agriculture, died at Dallas, Texas, on June 19, 1923, in his forty-sixth year. His scientific studies and publications were concerned with metabolism, enzymes, insecticides and fungicides.

Robert Woolston Hunt, the metallurgical engineer and founder of the firm bearing his name, died on July 11, aged eighty-five years. In 1912 he was awarded the John Fritz medal for his contributions to the early development of the Bessemer process.

Mr. S. S. Hough, F.R.S., astronomer at the Cape of Good Hope, died on July 8, aged fifty-three years.

Sir Henry Hoyle Howorth, F.R.S., an authority on politics, science, history and archeology, died on July 8, aged eighty-one years.

Sir Benjamin Simpson, formerly sanitary commissioner and surgeon-general with the government of India, died on June 27, aged ninety-two years.

THE death is also announced of Dr. H. Lacombe, professor of physical and natural sciences at the University of Rio de Janeiro, editor of the *Revista de Medicina*.

THE second International Congress of Comparative Pathology will be held in Rome from October 7 to 14. Information can be obtained from Professor Perronetto, 40, Corso, Valentino, Turin.

THE Sayre Observatory of Lehigh University has been closed, as the observatory is rendered useless for accurate scientific work by the vibration of the earth caused by the passage of street cars a quarter of a mile away.

THE Committee on Guaranteed Reagents and Standard Apparatus of the American Chemical Society will hold an open discussion on chemical reagents at one of the sessions of the Industrial Division at the Milwaukee meeting. The discussion will be a friendly exchange of experiences such as might take place if two or three were talking together at lunch. The details of the meeting will not be published. Names, dates and analyses will be reported showing the good and bad reagents received at various laboratories. Manufacturers will be invited to explain some of their difficulties in finding out the requirements for various reagents and in meeting these requirements. In order that the time may be used to the greatest advantage any one who has definite facts to present should send a copy of his data to the chairman of the Committee on Guaranteed Reagents and Standard Apparatus, W. D. Collins, U. S. Geological Survey, Washington, D. C. It is possible that the amount of material to be presented will not leave much time for general discussion or for the reciting of facts not previously submitted to the committee. Instances of good service and deliveries of exceptionally good reagents will be more valuable to the hearers than instances of the opposite kind.

WM. GAERTNER & Co., manufacturers of scientific instruments, who have been located at 5445-49 Lake Park Avenue, Chicago, for over twenty-five years, have commenced building a factory and office building, which will occupy the southwest corner of Wrightwood and Racine Avenues. The new building, 154 x 135 feet, will cost in the neighborhood of $150,000. It has been designed by the Chicago architects, Schmidt, Garden and Martin, and will be equipped with all modern facilities for the production of scientific instruments, including astronomical telescopes.

A TRACT of forty-four acres of land in Minneapolis on the banks of the Mississippi River, valued at $100,000, and an endowment fund of $900,000 have been given to the University of Minnesota for the construction and endowment of a hospital and convalescent home for crippled children. This gift is from William Henry Eustis, a former mayor of Minneapolis, who a month ago presented 21 acres of land to the city as a site for the Dowling School for Crippled Children, which the board of education of Minneapolis will erect. The children's hospital will be erected on the campus of the medical school, and the riverside tract will be retained as a site for the convalescent home.

IT is planned to hold a reunion of former students and staff members of the Lick and Students Observatories of the University of California on Tuesday, September 18, at Pasadena. All interested are urged to arrange to be present.

UNIVERSITY AND EDUCATIONAL NOTES

THE General Education Board of the Rockefeller Foundation has promised Oberlin College $500,000 on condition that an additional $1,500,000 be raised.

DR. ERNEST DEWITT BURTON, who has been acting president of the University of Chicago since the retirement of President Harry Pratt Judson in February, was elected president of the institution at a meeting of the board of trustees on July 12.

DR. F. L. RANSOME, geologist of the U. S. Geological Survey since 1900, has accepted an appointment as professor of geology and head of the department at the University of Arizona.

DR. ERNEST ANDERSON, for the past three years professor of general chemistry in the University of Nebraska, has been appointed professor of chemistry and chairman of the department of chemistry in the University of Arizona.

DR. GEORGE W. PUCHER has been appointed associate in the department of biological chemistry, University of Buffalo Medical School. He will retain a consulting and research connection with the Buffalo General Hospital.

DR. V. H. YOUNG has resigned the headship of the department of botany and plant pathology at the University of Idaho to become head of the department of plant pathology at the University of Arkansas.

IN the department of anatomy at Cornell University Medical College the following promotions have been made: Robert C. Chambers to professor of microscopic anatomy; Charles V. Morrill to associate professor of anatomy, and George N. Papanicolaou to assistant professor of anatomy. Dr. Louis Hausman is appointed an instructor in anatomy.

DR. J. READ, professor of organic chemistry since

1916 in the University of Sydney, has been appointed to the chair of chemistry in the University of St. Andrews.

DISCUSSION AND CORRESPONDENCE

THE UNIVERSITY OF TENNESSEE AND PROFESSOR SCHAEFFER

THE Board of Trustees of the University of Tennessee has dismissed five professors from the university, among them, Dr. A. A. Schaeffer, professor of zoology. The dismissal of Professor Schaeffer seems especially significant inasmuch as he is president of the local chapter of the American Association of University Professors, and this chapter had made request for an investigation of the case of Professor Sprowls, who was dismissed from the university some months ago. No satisfactory reason for the dismissal of Professor Sprowls has been given, it may be mentioned incidentally, but it is believed that a certain opposition to his introduction of the evolutionary point of view into his educational work contributed to the result. Professor Schaeffer was at the Marine Laboratory of the Carnegie Institution of Washington in the Gulf of Mexico when dismissed. Immediately before leaving Knoxville in June the president discussed with him a special appropriation for his laboratory and was far from showing any dissatisfaction with him. The action of the president seems to be a direct challenge to the American Association of University Professors to show whether it has any potency. Meanwhile the loss of Professor Schaeffer to the University of Tennessee is bound to be the gain of some other university.

CHAS. B. DAVENPORT

THE STREAMS OF LONG ISLAND

THE interesting difference between the east and west banks of the streams of Long Island has been the basis of suggestive comment by contributors to SCIENCE. Jennings,[1] who doubts that the westerly deflection of the streams by the earth's rotation is most largely responsible for the steeper west bank and the imperceptibly sloping eastern one, is more inclined to attribute these conditions to the cumulative effects of wind and wind-borne materials, particularly after consideration of the geological history of the region. Hayes[2] states that because of the earth's rotation, longitudinal rivers in the northern hemisphere erode their right banks, whether they flow north or south, while Davis[3] recalls that in the plateau of Launemozen, at the northern base of the Pyrenees, the valley sides facing against the wind are the steeper, while in Long Island they face with the wind. French physiographers explained the former condition not as a consequence of the earth's rotation, but as the result of the stronger action of rain driven by westerly winds. In this case it is of course conceivable that drifting materials would be held in quantity by the denser vegetation of the moister stream margin only when other conditions enabled vegetation to be present in a quantity sufficient to retain it, and to prevent the erosion of that bank. This presumably finds additional explanation in the downward sweep of the winds.

Following Jennings's suggestion, I have studied cross sections of the banks of four small streams of Long Island, two near Oyster Bay, one below Mineola and one emptying near Glen Cove. Comparative cross sections of the steeper west bank and the eastern one indicated that pebbles of a size easily movable by the wind were by far the most common in the west bank, their place being taken by coarse gravel in the eastern one. In these sections, the black topsoil above the yellow sandy clay was in the western bank usually 2–3 times the thickness of the smaller deposit in the eastern bank. Further, faint lines of stratification could be seen as indicated by coarser vegetable remains. These facts indicate that the cumulative effects of wind and vegetation upon wind-borne materials explain in large part at least the steeper west bank of Long Island streams.

N. M. GRIER

DARTMOUTH COLLEGE

[1] Jennings, O. E., SCIENCE, LV, p. 291.

[2] Hayes, E., SCIENCE, LV, p. 567.

[3] Davis, W. M., SCIENCE, LV, p. 478.

SCIENTIFIC BOOKS

Earth Evolution and its Facial Expression. By WILLIAM HERBERT HOBBS. The Macmillan Company, New York, 1921, 178 pages.

THIS interesting and suggestive book deals with major problems in advanced dynamical and theoretical geology. It represents the results of a long period of thought and study on the part of the author of the "fundamental questions of theoretical geology which are in one way or another connected with the growth of continents and mountains." The book is divided into fourteen chapters.

In Chapter I the field of cosmogony is traversed in a brief and general way. Reference is made to the conceptions of Greek, Latin and other philosophers of antiquity. The views of early modern thinkers are considered, together with the origin and rise of the nebular hypothesis. The author regards the objections to this hypothesis as fatal, and adheres to the planetesimal hypothesis, although in the development of his conceptions he departs markedly from certain postulates of that hypothesis.

The nature of the earth's interior is considered in Chapter II. The arguments supporting a solid, rigid and elastic condition for the earth's interior are emphasized, but a new conception is offered to explain the arrangement of denser and lighter material within the earth. It is assumed that a selective addition of meteoric (planetesimal) material obtained during the growth of the earth, resulting in a core of meteoric stone-iron, surrounded by an intermediate shell of meteoric nickel-iron, with an outer shell composed of meteoric stony matter enveloped by a skin or rind possibly less than 10 km. thick composed chiefly of sediments. It is further suggested that the central core has a radius of 3,500 km. with an average density of 6.93, that the intermediate shell is 1,700 km. thick with a density of 7.6, and that the outer shell has a thickness of 1,200 km. and an average density of 3.6.

Vulcanism forms the theme of five chapters. The author maintains that temperature and aqueous conditions are such that rocks may fuse within the earth's rind of sediments, and probably not more than six miles below the surface. It is concluded that shales constitute the source of essentially all lava, for they make up the bulk of sediments, they are very similar in composition to igneous rocks, with a range in fusibility near the temperature of lava. It is further contended that this mode of origin of lava readily explains the conceptions of "consanguinity" and "petrographic provinces."

The fusion of shale is regarded as resulting from relief of pressure following block faulting and folding. Block faulting is considered as due to compression rather than tension, the compression elevating segments, the heavier, competent strata of which tend to separate from the weaker shale members below. The lava from the fusion of the shale is squeezed out along fissures bounding the blocks by the weight of overlying rock and by the jolting effects of earthquake shocks. This lava is basic in composition, for it is derived from calcareous shale resting beneath competent limestone beds, that being the order of deposition in a transgressing sea. Later lava of andesitic and more acid types may be exuded due to extension of magma chambers downward into shale of average composition and siliceous shale.

In folding shales located in the lower part of anticlinal arches fuse as a result of the lifting of their load by stronger members involved in the fold. Continued application of lateral pressure and underturning of the folds squeeze out the magma. In this case the lava is of average composition derived from the fusion of shale of average composition, that shale being forced into a superior position in the anticline, as shown by experiment. Later fusion of lower siliceous shale would give rise to dacitic and rhyolitic lava, and the formation of secondary anticlines paralleling the principal folds would extend the lava chamber upward into higher calcareous shale, basaltic lava resulting to be extruded as a later phase of the vulcanism associated with growing mountain folds.

The author does not regard laccolites as the result of intrusion, but considers them as illustrating initial efforts towards folding, the competent strata rising in domes and shale below migrating inward to be fused in a lava pocket. The same idea is applied to the origin of sheets, and the conception is extended to the origin of batholiths forming cores of recently elevated folded mountain ranges.

Gases present in lava are all to be accounted for by the materials already present in the original shale, or by accessions secured during the ascent of the magma. The source of the atmosphere under this conception is not apparent.

Six chapters are devoted to the consideration of the earth's physiognomy. In the first of these chapters, Chapter VII, the author considers the change of figure through which the earth has passed. He follows the tetrahedral theory, a theory that has not found wide acceptance among geologists because of the mechanical difficulties in the approach to such a form by a rapidly rotating, solid, elastic spheroid. Students of historical geology will find the illustrations accompanying this portion of the text interesting even if they do not agree with the conceptions the figures are intended to convey. In the development of this chapter the author gives scant heed to the "permanence of the ocean basins," a theory he regards as untenable.

A chapter is devoted to the rapidity of geologic changes. The border zone of the Pacific and the zone traversing the Mediterranean Sea of Europe and America are considered as regions where geologic changes are going on rapidly to-day—a testimony to the rapidity of geologic changes in general, and a challenge to the orthodox view concerning the time necessary for the accomplishment of past geologic changes. Few geologists will be found to agree with Professor Hobbs in his position on this question. In fact, the investigations of the last two decades in earth genesis, historic geology, radioactivity, etc., have emphasized the enormous duration of geologic time.

The author follows Suess in dividing the continental areas into two sections, one characterized by folded structures, the other by plains and plateaus. He likewise considers the folded structures as arcs developed with convex faces and steeper sides facing oceans existing at the time of their formation, and festooned about old lands of earlier eras. The thrust responsible for the formation of the arcs, however, is

regarded as generated by a subsiding ocean floor and directed against strata near the coast, producing underthrust folds with thinned under limbs, and bordered on their outer sides by synclinal fore-deeps. The Appalachians, Rockies and other mountain systems are taken as examples. In the first case it is assumed that the thrust came from the interior (Mississippi valley) sea, not from the east as usually supposed; in the case of the Rockies the thrust came from the Cretaceous sea covering the region of the Great Plains; and the thrust forming the Coast Ranges has come from the subsiding Pacific basin. The effect of the trend of the coast lines on the shapes of arcs rising off their shores is elaborated.

In the closing chapter on physiognomy the author reemphasizes his well-known ideas regarding the intimate relationship existing between fractures and surface expression. It is pointed out that in the Great Basin province north-south and east-west fractures with their bisectrices are dominant, and Africa is regarded as divided into a fault mosaic by fractures developed in the same directions. This fracture system is also applied to southern South America, and the author concludes that this pattern of fractures is continental in extent and probably worldwide.

The conception is entertained that both fracturing and folding may go on simultaneously within the same strata, rather than limited to separate depth zones. The author does not regard the theory of a zone of fracture as distinct from a subterranean zone of flow as tenable.

The book closes with a concise survey of the field of theoretical geology in which the author enumerates the theories he regards as tenable and which are emphasized through the book, together with the theories that are rejected as not being tenable.

Albert W. Giles
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The Air and Its Ways. The Rede Lecture (1921) in the University of Cambridge with other contributions to meteorology for Schools and Colleges. By Sir Napier Shaw, Sc.D., F.R.S. With 100 figures, Royal 8vo, pp. xx + 237. Cambridge University Press, 1923. New York, The Macmillan Company. Price, $7.00.

Lectures and addresses on meteorological subjects are always easy to make and sometimes interesting to hear. So Sir Napier Shaw says and doubtless believes. But some of us on this side of the Atlantic can not help but qualify his statement with our own "That depends"—because of our own experience.

However, few of us can lecture or write like Sir Napier Shaw—more's the pity—and perhaps this is one reason why meteorology or to give it a modern and more suitable appellation, *aerography,*[1] makes but slow headway in university curricula.

The present volume is not a text-book. We have the author's word for that; and yet it certainly can serve as such and serve admirably in any university course on atmospherics, using this word in its general sense and not the restricted one, of irregular and unwelcomed static interferences with radio messages.

Sir Napier Shaw says frankly that the book shows meteorology (awkward word) in its workaday clothes, with loose or missing buttons here and there and the tailoring not always perfect. This may be so; but we fail to observe it; and the originality and attractiveness of the work permit no notice of defects in dress.

In the book there are essays on climatology, air physics, dynamics of the atmosphere, agriculture as dependent on weather; and much valuable historical matter.

In a brief review, these can not be dwelt upon, and it is enough to say that he who is interested in any one of these fields of applied science will find page after page of up-to-date information and stimulating discussion.

Sir Napier is himself easily the most suggestive of aerographers. In this book he brings out no less than three new lines of investigation, or, in his own words, "new meteorological principles, as inductively justified": First, the motion of the air under balanced forces; second, the *eviction* of air by turbulent motion as an inevitable concomitant of convection; and third, *stratification* in consequence of the resilience due to excess temperature. He hopes that the last will in time lead to satisfactory explanation of the formation of high pressure areas.

The book is in the main not beyond a layman's depth and seems to the reviewer to be exactly the type of book an instructor in aerography should own, read, re-read and ponder over.

Typographically, the book is beyond criticism, as well it might be, having been seen through the press by a master hand, being indeed the last work of Mr. J. B. Peace of the Cambridge University Press, the author's college friend of many years.

Alexander McAdie

ZOOLOGICAL NOMENCLATURE

The Secretary of the International Commission on Zoological Nomenclature has the honor to notify zoologists, especially icthyologists, that Professor David Starr Jordan and the U. S. Fish Commission concur in recommending the adoption of the general principle that names now current are not to be dis-

[1] Aerography, literally the air and its ways.

carded unless the data show this to be a clear cut necessity. Under this general principle, they propose that the following 14 generic names of fishes, in regard to which a difference of opinion exists, shall be provisionally legitimized with the types indicated:

Aëtobatus Blainv., 1816 (type, *Raja narinari* Euphrasen); *Conger* Cuv., 1817 (*Muraena conger* L.); *Coregonus* Linn., 1758 (*Salmo lavaretus* L.); *Eleotris* Bloch & Schneider, 1801 (*gyrinus* Cuv. & Val.); *Epinephelus* Bloch, 1792 (*marginalis* Bloch); *Gymnothorax* Bloch, 1795 (*reticularis* Bloch); *Lampetra* Gray, 1851 (*Petromyzon fluviatilis* L.); *Malapterurus* Lacépède, 1803 (*Silurus electricus* L.); *Mustelus* Linck, 1790 (*Squalus mustelus* L. [= *Mustelus laevis*]); *Polynemus* Linn., 1758 (*paradisaeus* L.); *Sciaena* Linn., 1758 (*umbra* L. = *Cheilodipterus aquila* Lacép. as restr. by Cuvier, 1815); *Serranus* Cuv. (*Perca cabrilla* L.); *Stolephorus* Lacép., 1803 (*commersonianus* Lacép.); *Teuthis* Linn., 1766 (*javus* L.).

The secretary of the commission will delay the vote on this case until one year from date, in order to give to the profession ample opportunity to express concurrence or dissension as respects any or all of these names.

C. W. STILES,
Secretary to Commission
WASHINGTON, D. C.

SPECIAL ARTICLES

NOTE ON THE THEORY OF PHOTOGRAPHIC SENSITIVITY[1]

THE very small amounts of substance involved in the formation of photographic latent images have prohibited conventional methods of chemical analysis. The ingenious attempt of P. P. Koch[2] to apply the Ehrenhaft condenser method to the initial reaction of silver bromide in light has apparently not yet given unobjectionable results. But in any case, the use of gelatin-free silver halide can not yet be regarded by the photographic chemist as significant for the gelatino-silver bromide of photographic emulsions. The generally accepted conclusion that the substance of the latent image in these consists of absorbed colloid silver has been reached by indirect methods, and is largely due to Lüppo-Cramer.[3]

Reasoning from the general principle that the fundamental photographic reaction $Ag^+ + \theta = Ag$ is autocatalytic in character, various investigators have suggested that the precursor of the latent image, the "sensitivity" of the silver halide grains, might itself be substantial in nature, and indeed actually itself colloid silver. Thus R. Abegg[4] brought forward evidence, inconclusive but suggestive, for "sensitizing" by finely divided silver. The idea that the "ripening" of silver bromide emulsions was associated with a partial reduction forming "Reduktionskeime" was advocated by J. M. Eder,[5] although this investigator regarded both the "Reduktionskeime" and the latent image as subhalides of variable composition Ag_mBr_m Ag_mBr_{m-n}. Evidence for the existence of such colloid silver nuclei in relation to sensitivity was brought forward by Lüppo-Cramer,[6] who found that the sensitivity of "ripened" emulsions could be reduced greatly by treatment with silver solvents such as a mixture of chromic and sulphuric acids prior to exposure. Again, one of the writers and A. P. H. Trivelli[7] showed that the development of latent images by fuming with ammonia, whereby a recrystallization of silver bromide on silver nuclei was effected, was accompanied by partial reduction of the halide to silver, increasing the probability that such reduction took place in the ammonia ripening of gelatino-silver bromide emulsions. The theory that sensitivity, at least in high speed photographic emulsions, is due to colloid silver was put forward in a very striking form by F. F. Renwick.[8] He suggested that the change involved on exposure of these is entirely limited to the preexistent colloid silver, which he supposed to be converted by light from a charged "sol" form to a neutral "gel" form, the former being incapable of initiating development, the latter able to act as nuclei for the actual reduction of the silver halide by developers. Quite independently, F. Weigert[9] brought forward evidence that in "printing out" with silver chloride plus silver citrate, the actual light sensitive substance was colloid silver; that this reacted initially according to the Einstein photochemical equivalence principle, one quantum $h\nu$ being photochemically absorbed per atom of (colloid) silver.

Proof or disproof of this hypothesis is equally difficult to obtain. But inferential evidence of the same character as that regarded as establishing the nature of the latent image has been obtained by the writers recently. In a recent paper[10] they have pointed out that a discrimination between the hypotheses that sensitivity is due (a) to a photocatalyst, *e.g.*, colloid sil-

[1] Communication No. 185 from the Research Laboratory of the Eastman Kodak Company.

[2] *Zeit. fur Physik, 3*, 169–74 (1920).

[3] Das latente Bild. (W. Knapp, Halle; 1911).

[4] *Arch. wiss. Phot. 1*, 18 (1899).

[5] Cf. Lüppo-Cramer, *op. cit.*

[6] Phot. Mittl., 1909, p. 328.

[7] "The Silver Bromide Grain of Photographic Emulsions," 1921, p. 25 (Van Nostrand, N. Y.).

[8] *J. Soc. Chem. Ind.*, 1920, p. 156T.

[9] Sitz. ber. Bul. Akad., p. 641 (1922).

[10] *J. Frankl. Inst.*, 1922, p. 486.

ver, in the silver halide grains, (b) to the quantum character of light radiation in relation to size of grain,[11] might be obtained by Lüppo-Cramer's desensitizing action with chromic acid *et similibus*.

In a subsequent letter to the *British Journal of Photography*[12] it was pointed out that this required that the desensitizer be removed from the emulsion *prior* to exposure, as otherwise it might act *during* exposure by destruction of nascent latent image. By methods which will be described in a fuller communication they have shown this to be possible, and extended the desensitizing reaction to layers one-grain thick[13] for which diffusion phenomena are practically negligible, and which are susceptible of microscopic statistical investigation. With these they have succeeded in showing that the desensitizing effect is a function of grain size, being less for large than for small grains in the same emulsion. This reaction, in itself, does not necessitate Lüppo-Cramer's conclusion that the chromic acid, or other oxidizer, must be acting as a *silver solvent*. It is equally conceivable that some, perhaps reducing, substance derived from the gelatin is acting as the photocatalyst and is destroyed by the chromic acid. Lüppo-Cramer's observation that the desensitizing action becomes more and more effective as the ripening (by digestion) increases is suggestive, but not cogent, evidence for the "silver" hypothesis. He has, however, furnished another method of attack which we have employed. In explanation of the acceleration of development with certain developers by prebathing with potassium iodide,[14] Lüppo-Cramer brought forward the hypothesis of "Keimblosslegung," *i.e.*, the hypothesis that the partial converison of silver bromide to iodide made occluded colloid silver of the latent image more active. This hypothesis was contested by one of the authors and G. Meyer[15] on certain grounds which need not be recapitulated here. Lüppo-Cramer has pointed out[16] that his hypothesis does not rest on the development acceleration alone, but is more strongly supported by the following observation. If a plate is divested of the soluble non-occluded latent image by chromic acid mixture, it gives practically no image with physical (acid silver) development. If such a plate is now treated with potassium iodide and developed, a full image is obtained. This Lüppo-Cramer attributes to the "Keimblosslegung" of the occluded latent image. We have repeated these experiments in detail, and with variations to be described more fully elsewhere. Although not convinced that the "Keimblosslegung" is a satisfactory explanation of the development acceleration previously noted, we consider that Lüppo-Cramer's position in regard to the oxidation experiment is well grounded. In particular, the fact that a *repetition* of the sequence chromic acid : potassium iodide yields *no* image strongly supports the view that the first iodide treatment does set free the occluded colloid silver nuclei. Now we have applied this reaction to the *desensitizing process* with chromic acid described above, and find that treatment with potassium iodide after chromic acid gives practically the same effect as treatment with iodide alone; but a further treatment with chromic acid enormously reduces the sensitivity. The similarity of this to the reaction of the *latent image* is evident.

If the desensitizing action of the chromic acid consisted in destroying a reducing substance from the gelatin, there is no apparent reason why this should be reformed by iodide. On the other hand, if the action of such a substance consists in a slight reduction of the silver halide, some part of the reduction product, colloid silver, being occluded in the grain, it is comprehensive that iodizing would again bring it into activity, *i.e.*, to the surface of the grain.

These results are in harmony with the localization of the "sensitivity" in "spots" or "centers" on the grain, as demonstrated by Svedberg[17] and confirmed by Toy.[18] It appears that any quantum theory of exposure must be limited to collisions with sensitive spots, *probably of colloid silver*, and consisting of only a few atoms of metallic silver. A restriction of this character has been recognized as necessary by Silberstein in a modified form of his theory[19] in consequence of measurements of Jones and Schoen[20] which showed that in Trivelli and Righter's experiments some 300 quanta of λ 420 $\mu\mu$ were incident per grain of 1 μ diameter.

We may suppose that the first action of light is to release a photo-electron from the colloid silver speck. This would require less energy than to release one from the bromide ion of the Ag^+Br^- lattice, owing to the strong electro-affinity here. The colloid metallic silver may be considered as a lattice of silver atoms intermeshed with a lattice of electrons, the latter being active both in conduction and photo-electrically. The free electron, having a kinetic energy $\frac{1}{2}mv^2 = hv$,

[11] L. Silberstein, *Phil. Mag.*, *44*, 257 (1922), A. P. H. Trivelli and L. Righter, *Phil. Mag.*, *44*, 252 (1922).

[12] *Brit. J. Phot.*, 1922, p. 51.

[13] On the technique of these, see Wightman, Trivelli and Sheppard, *J. Phys. Chem.*, *27*, 7 (1923).

[14] The so-called Lainer effect; *cf.* Lüppo-Cramer, Kolloidchemie und Photographie, 2nd Ed., p. 63 (1922, Steinkopf, Dresden).

[15] *J. Amer. Chem. Soc.*, *42*, 689 (1920).

[16] *Koll, Zeitschr.*, *30*, 186 (1922).

[17] *Phot. J.*, *62*, 186, 310 (1922).

[18] *Phil. Mag.*, 44, 352 (1922).

[19] *Phil. Mag.* (in press).

[20] *J. Opt. Soc., Am.*, 7, 213 (1923).

where v is the wave-length of the active light, is then able to enter the silver ion, forming a neutral silver atom $Ag^+ + \theta = Ag$, while the unneutralized bromide ion loses an electron. $Br^- = Br + \theta$. This chain reaction, analogous to that suggested by Bodenstein for the action of light on $H_2 + Cl_2$, would go on to a limiting state, depending on the initial energy of the photoelectron, but producing a nucleus large enough to initiate development for a developer of given reduction potential.

A fuller account of the experimental work is to be published in collaboration with Mr. A. P. H. Trivelli.

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A METHOD OF ULTRAMICROSCOPY WHEREBY FLUORESCENCE IN THE CYANOPHYCEAE AND DIATOMACEAE MAY BE DEMONSTRATED

AT the recent meeting of the Royal Society of Canada I demonstrated the fluorescence of the Cyanophyceae. On returning to my laboratory I succeeded by the same means in finding that nearly all diatoms which I could find are also visibly fluorescent. In this regard the pigments involved stand in contrast to chlorophyll, inasmuch as the latter when in the living cell is not visibly fluorescent save when viewed spectroscopically, or by means of ultraviolet light. Raehlmann[1] believed, however, that he could detect it in suspensions by means of the ultramicroscope, but the fact was called in question by Czapek.[2] The reason of the non-visibility of the fluorescence of chlorophyll lies in the physical relation of this pigment to its carrier, so that the complex behaves optically like an emulsion or solid solution as, *e.g.*, chlorophyll in paraffin as J. Reinke[3] showed. It is, I think, possible to detect, by the optical means to be mentioned, slight evidences of the fluorescence of chlorophyll in the chloroplasts of *Spirogyra* and in some other plants, but they are not convincing. Not so, however, the phycocyanin of the blue-green algae and a certain red-fluorescent pigment in the diatoms. The following optical conditions enable one to observe this. They furnish indeed the most astonishingly striking and beautiful object pictures of these organisms one can imagine.

The necessary condition to achieve this result is that the organisms be viewed by means of brilliant reflected light derived from a dark field condenser. This can not be done if the glass slide is of the thickness called for by the current rules of the ultramicroscopy game, since then the light which falls on the object does so from beneath, and if the object be translucent, it passes through it towards the observer. If, however, a thin slide, one, that is, about 0.8 mm. thick or less, is used, one can raise the dark field condenser sufficiently high to cause the light cone to be reflected from the upper surface of the cover glass, provided, however, that a dry objective is used. The light now passes downward, so that the object is illuminated from above, and is seen by reflected light. When blue-green algae are thus viewed, the fluorescence of many kinds becomes readily visible. In some it can be seen only somewhat faintly, because of the numerous bright granules which furnish reflecting surfaces and so produce the effect of an emulsion. If, however, the organisms be mounted in glycerin the extraneous light is obviated, when the cells glow with a fervent light with its characteristic fluorescence color. *Rivularia, Cylindrospermum,* some species of *Oscillatoria,* rich blue-green by transmitted light (ordinary microscopy) and brilliantly outlined and accompanied by diffraction images when seen at the apex of the light cone, when seen at the apex of the inverted light cone become deep crimson. By meticulously focussing the condenser and objective at the same time, one obtains combinations of outline object pictures and fluorescence of rare beauty. Other species of *Oscillatoria,* some *Chroococcus* forms, and others have a yellower or golden sheen, while a species of *Nostoc* is bright orange. The cells of *Nostoc commune* obtained by crushing a gelatinous filament from some material (from China) given to me by Professor H. M. Richards about twenty years ago, glow deeply red. while the matrix appears a pale blue, perhaps because of adsorbed phycocyanin.

The visible fluorescence in the diatoms is confined to certain vacuoles which, by transmitted light, appear a pale greenish yellow, and which take up Sudan III. The pigment may be inferred to be oil soluble, and may be a chlorophyll, with the properties of chlorophyll alpha. It is not readily destroyed by heating, as is phycocyanin. Because of the numerous sources of reflection, the fluorescence can not be seen, or certainly can be seen only with difficulty, unless the material is mounted in glycerin. When thus viewed, the vacuoles, seen as blood-red, stand out in some species with great clearness. In *Navicula* there are two large vacuoles (as currently described) one on either side of the nucleus with its surrounding cytoplasm. Generally two smaller fluorescent vacuoles occupy the ends of the cell. In *Meridion* when small there may be but one large vacuole. In larger cells three smaller ones may occur. A circular colony of

[1] Raehlmann, E. Neue ultramikroskopische Untersuchungen über Eiweiss, etc. *Arch. ges. Physiologie,* 112: 128. 1906.

[2] Biochemie der Pflanzen. *1*: 564.

[3] Die optischen Eigenschaften der grünen gewebe, etc. *Ber. d. D. B. G.* 1: 395. 1883.

this organism with its green chloroplasts and intermingled red fluorescent vacuoles vies with a jewel set with emeralds and rubies for beauty.

Some of the *Pleurococcaceae* undoubtedly also are visibly fluorescent. I cite *Scenedesmus* and *Raphidium* (or it may be *Selenastrum*) as examples.

The best results are obtained with a cardioid dark field condenser, and when one is especially studying colors, an arc light. A 400-Watt condensed filament lamp serves well enough otherwise. Water instead of oil does between the slide and condenser, obviating messiness. I venture to believe that, when the above results are experienced, the use of the dark field condenser will be widely extended. Some of my own observations, accompanied by discussion thereupon, will appear in the forthcoming proceedings of the Royal Society of Canada.

The method of making use of the reflected hollow light cone derived from the dark field condenser has, I think, not consciously been taken advantage of. It very greatly enhances the value of this optical apparatus, as I have already found. The first sight of these fluorescent organisms invariably calls forth expressions of delight, and the experience recalls one's childhood days when the wonders of the microscope were real wonders.

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QUOTATIONS

RESEARCH AS A PROFESSION

Towards the end of last February Sir Alfred Yarrow gave £100,000 to the Royal Soicety to mark his sense of the value of research to the community. He gave it to be used as capital or income, as the council of the society might think fit, because he recognized "that conditions alter so materially from time to time that, in order to secure the greatest possible benefit from such a fund, it must be administered with unfettered discretion." To emphasize this point Sir Alfred Yarrow suggested that any rules made for the administration of the fund should be reconsidered by the council every tenth year, so as to meet modern needs. While leaving the council this valuable discretion, he expressed his hope that the money would be used to aid scientific workers by adequate payment, and by the supply of apparatus or other facilities, rather than upon erecting costly buildings on which large sums of money are sometimes spent without adequate endowment, so that "the investigators are embarrassed by financial anxieties."

The council of the Royal Society has given attention to the best way of using Sir Alfred Yarrow's gift, and has this week published the result of its deliberations. The official announcement states that on reviewing the situation it appeared to the council "that there was a marked deficiency of positions in which a man who had already proved his capacity could continue to regard research as the main occupation of his life. Consequently at the council meeting of the fifth inst. it was finally decided to use the larger part of the income in the direct endowment of research by men who have already proved that they possess ability of the highest type for independent research. To this end a number of professorships will be founded, of type similar to the Foulerton professorships, which were founded by the society in 1922 for research in medicine. The professors will be expected to devote their whole time to scientific research, except that they may give a limited course of instruction in the subjects of their research to advanced students. There is at present a tendency to regard scientific research as a secondary occupation for men whose primary occupation is the teaching of students. The intention of the Royal Society in founding these professorships is to recognize research as a definite profession."

We make no doubt that the council of the Royal Society has rightly interpreted Sir Alfred Yarrow's wishes, and it will be observed that the two gifts which have recently been received by it—the Foulerton and Yarrow funds—have enabled it to establish a precedent new in this country at least, and not very common in any other. This new precedent is that research shall be the primary object of the incumbent of one of these professorships, and not, as has usually of necessity been the practice, an occupation secondary to the teaching of students. Sometimes, it is true, the occupant of a university chair has put research first and teaching second, but as it is his duty to teach, the university authorities may be disposed to grumble—not without some reason. No doubt the stimulus provided by a class of students is useful to some men, but, as Sir George Newman has more than once reminded us, the art of teaching requires special training and, perhaps even more, a special aptitude. A man may be an excellent teacher—many examples will come to mind—and not good at research work. The converse also is true. The two aptitudes do not always exist together, and there have been great scientific investigators who had no aptitude for teaching, except by example to a chosen few who assisted in the laboratory. The result of the great experiment the Royal Society is now able to conduct will not be known perhaps for a generation, but in its hands, and administered, as the donor desires, "by the best people from time to time available," there can be no doubt that the scheme must have a favorable influence on the progress of science in this country.—*The British Medical Journal.*